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PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

IN THE APPLICATION OF | DOCKET NO.: 2964R

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SERIAL NO.: 09/659,132 | EXAMINER: J. JOHNSON

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TITLE: MODIFIED POLYISOBUTYLENE SUCCINIMIDE DISPERSANTS HAVING IMPROVED SEAL, SLUDGE, AND DEPOSIT PERFORMANCE

Wickliffe, Ohio

Hon. Assistant Commissioner for Patents
Washington, DC 20231

Sir:

DECLARATION UNDER 37 C.F.R. §1.132

I, William D. Abraham, declare as follows:

I received a B.S. degree in Chemistry in 1985 from Purdue University and a Ph.D. degree in Organic Chemistry in 1990 from the University of Pittsburgh.

I have been employed by The Lubrizol Corporation since 1990. Since that time I have been responsible for inventing and preparing new anti-wear/antioxidant chemistries as a Research Chemist in the department of Chemical Synthesis, and for addressing customer service requests, performing molecular structure characterization using spectroscopy and/or chromatographic methods, and method development in the department of Physical & Analytical Sciences. I have also been responsible for managing eight chemists as a supervisor of the Molecular Structure Group in the department Physical and Analytical Sciences Department. For the past four years, I have been responsible for developing new lubricant additives and formulations as a project manager/formulator for the passenger car motor oil and heavy duty diesel market segments.

I certify that this correspondence is being transmitted by telefax to 703-305-3599 [No. of pages: ____________]

on ______________________________ By: ______________________________

I am a coinventor of the above-mentioned case and I am familiar with the references which were used in the rejection thereof. In order to illustrate the improvement in performance of the compositions of the above invention, the following experiments were performed under my direction and control.

Dispersants were prepared within and outside the scope of the claims of the present application. Samples of polyisobutene, each having a number average molecular weight of about 2000, were selected. The samples were subjected to no vacuum stripping, or various extents of vacuum stripping, to provide polyisobutenes having varying levels of low molecular weight (less than 500, number average) component. The amount of the low molecular weight fraction in the samples was 7.1%, 15.4%, 18.6%, or 24.1%. The middle two values are within the scope of the present claims. The compositions at 24.1% are not believed to represent the closest prior art but are included for completeness.

Each of the fractions of polyisobutylene was reacted with maleic anhydride to form the hydrocarbyl-substituted succinic anhydride, by conventional means. The hydrocarbyl-substituted succinic anhydride was, then, reacted with heavy polyamines which contain greater than 95% molecules of 7 and greater nitrogen atoms, to form the succinimide dispersant.

Each of the detergents is subjected to a series of tests typical of performance in an engine oil formulation.

The soot handling test is a dilution screen test, run on the lubricant used in a Mack™ T-8 engine which has been subjected to the ASTM D 5967 test. The drain oil after the test is treated with 0.2% and 0.5% (w/w) of the test detergent. Results are presented as "D-value," which is a measure of the ability of a detergent to restore the soot-mediated thickening of a drain oil to its original condition. A value of 0 indicates no effect, and a value of 1 indicates that the viscosity is restored to that of the new oil. D is defined as follows:

$D = [X-(1/\text{referernce ratio})]/(\eta_{\text{reference @ 100 s-1}}/\eta_{\text{new @ 100 s-1}}) - (1/\text{reference ratio})$

where $X = (\eta_{\text{reference @ 10 s-1}}/\eta_{\text{sample @ 100 s-1}})/$ sample ratio

reference ratio = $(\eta_{\text{@10 s-1}}/\eta_{\text{@ 100 s-1}})$ for the untreated oil

sample ratio = $(\eta_{\text{@10 s-1}}/\eta_{\text{@ 100 s-1}})$ for the drain oil + dispersant

Thus, higher values are better, as they signify greater ability to disperse soot. The test using 0.20% of the dispersant is generally considered a more severe and thus a more useful test for differentiating performance, compared with the tests at higher dispersant levels.

The 1173E Sludge Test is conducted by mixing the test oil with acid and iron catalyst, purging with nitric oxide, and holding the sample at 145°C. At intervals

during the test run, a drop of the oxidized/nitrated oil is placed on chromatography paper. The resulting spot is analyzed for the degree of dispersion; the number of hours intot the test that the sample begins to form a sludged spot is reported as Hours To Failure.

Kinematic Viscosity at 100°C and 40°C is measured by ASTM D-445 and reported in units of cSt. Cold Crank Simulator viscosity at -15°C is measured by ASTM D-5293 and reported in units of cP (10^{-3} Pa-s).

The copper and lead corrosion test "HTCBT" is specified in ASTM D 6594. The results are expressed in parts per million (ppm) of the metal; lower values are superior.

The results of the testing are presented in the following table:

Example:	1 (comp.)	2	3	4 (comp.)
% low m.w. substituent →	**7.1**	**15.4**	**18.6**	24.1
Test:				
Soot, T-8, D-values				
0.5%	**0.04**	**0.08**	**0.13**	0.10
2.0%	0.36	0.38	0.40	0.35
Sludge test #1173E, hours	**99**	**≥122**	**116**	115
Viscosity				
100°C (cSt)	15.77	16.05	16.60	16.29
40°C (cSt)	114.91	118.62	122.69	120.36
-15°C (cP)	2874	2787	2802	2822
HTCBT Corrosion (2 runs)				
Cu	27, 90	102, 127	136, 142	123, 120
Pb	87, 78	84, 49	64, 72	65, 63
Rating	4A, 4B	4C, 4C	4C, 4C	4C, 4C

closer to 1.0 the better

lower values are better

The results show that the dispersants having, in particular, 15.4 and 18.6 mole percent of the substituent groups with a molecular weight of less than 500 exhibit significantly improved performance in terms of soot handling and sludge, compared with the material having only 7.1 percent of the low molecular weight substituent. Compared with the 24.1 percent material, performance in the soot test is also notably improved and the performance in the sludge test is marginally improved.

The viscosity at 100°C is higher (better) for the inventive samples compared with the 7.1% sample, and the viscosity at -15°C is lower (better). The inventive samples exhibit less change in viscosity between low and high temperatures than does the 7.1% sample.

The Cu and Pb corrosion test does show slightly better performance for the 7.1 percent material, but this is readily correctable by minor modifications to the formulation and is not considered particularly significant. I present the data on corrosion for the purpose of completeness.

Performance of the fluids on seals was measured using the MTU FKM fluorinated seal test. The results are not reported, as all samples satisfactorily met or exceeded the passing criteria, although the 24.1% material exhibited only a borderline pass, and the 7.1% material passed with somewhat better scores in some of the evaluations than the other materials. This information is also mentioned for the purpose of completeness.

I conclude that the dispersants prepared according to the present invention exhibit significantly improved properties of soot handling and sludge reduction, compared in particular to the material made from the polyisobutene having only 7.1% of material of molecular weight less than 500.

I further declare that all statements herein made of my own knowledge are true and all statements herein made on information and belief are believed to be true. I understand that willful false statements and the like are punishable by fine or imprisonment or both (18 U.S.C. 1001) and may jeopardize the validity of the application or any patent issuing thereon.

William D. Abraham

10/10/02 (date)